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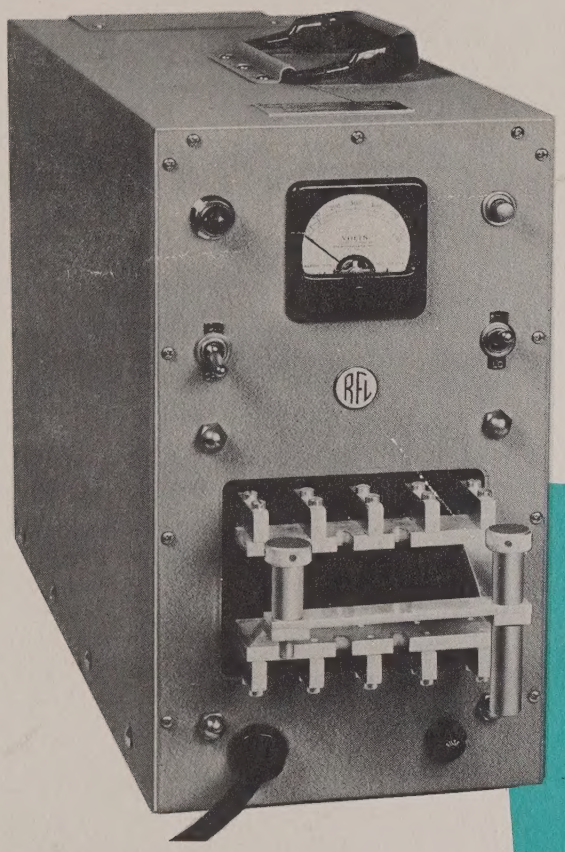


Handbook of Instructions

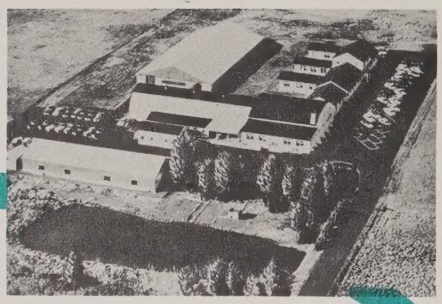
RFL Magnet Charger

MODEL 107A

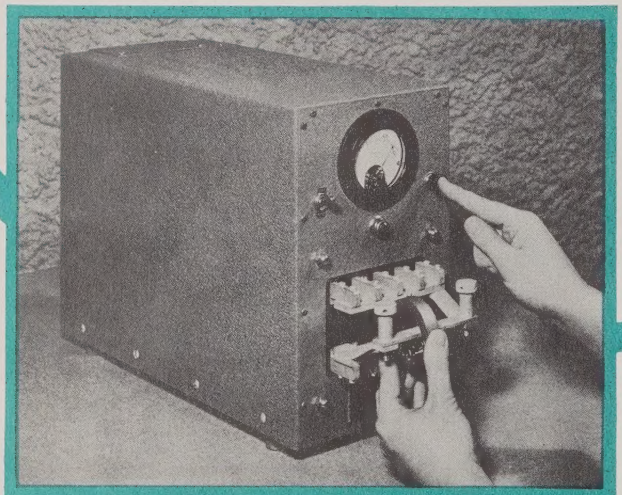
Radio Frequency Laboratories, Inc. BOONTON, N.J., U.S.A.

America's Most Comprehensive Line of Magnetics Equipment

THE STORY *of the* Magnet Charger



MODERN plant, adjacent to private airfield, has every facility for design and manufacture of precision electronic equipment.



The first Model 107 Magnet Charger.

At the request of the Air Force in 1944, the Weston Electrical Instrument Corp. designed the Model 825 Magnet Charger for re-charging electrical instrument magnets after repair and overhaul in the field. Prior to this, instruments had been returned to the factory or an authorized service station for repair - a procedure no longer possible with such accelerated volume and widespread use. RFL built the first units for Weston and continued their manufacture after the war, changing the model to 107. In 1954 the unit was further improved and became the Model 107A.

Basically the unit provides a convenient solution to the problem of charging the many shapes and types of magnets used not only in electrical instruments but in all applications containing permanent magnets. There is hardly a useful shape that it cannot charge using special adapters designed for the particular magnet where the I-bar or flat bar is not adaptable. As an owner of the Model 107A you are entitled to free engineering consultation and adapter design service whenever the need arises.

RFL

Designers and Manufacturers of Electronic Equipment since 1922

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Book No. MA-1563K

GENERAL DESCRIPTION

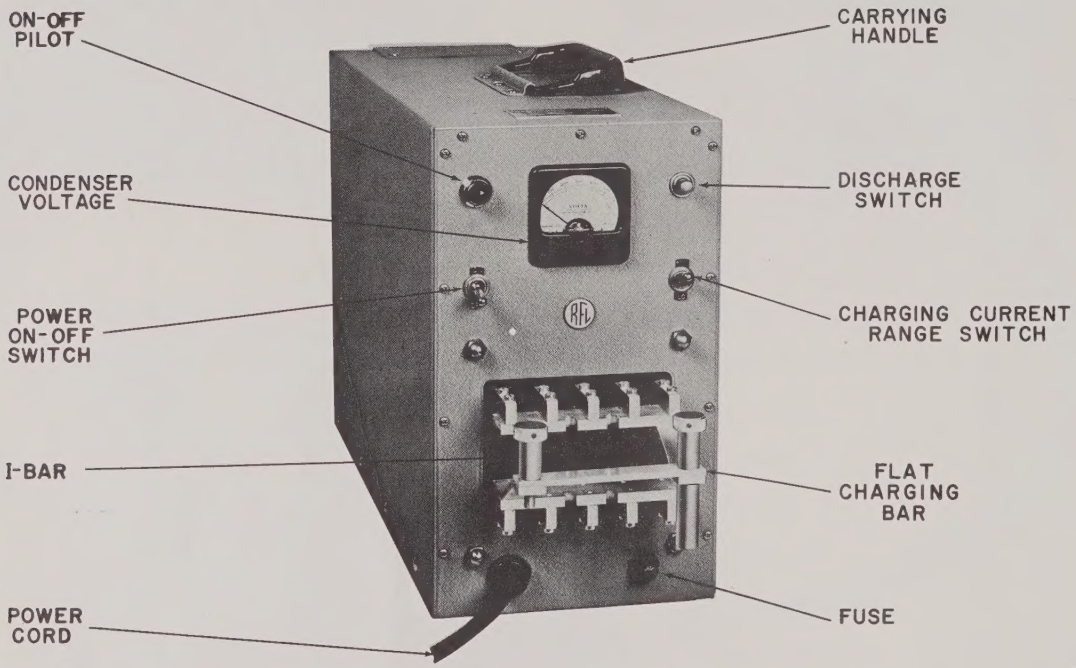

Figure 1.

The Model 107A Magnet Charger is a condenser discharge impulse type charger capable of magnetizing to saturation practically all permanent magnets in common use. All controls and indicators are located on the front panel (see figure 1). A terminal strip for connecting accessories, such as the Model 206 Booster Unit, Model 889 Magnetreater and wire-wound charging fixtures is located on the back of the chassis under a protective cover plate. The power cord plug fits any standard 110/120 volt, 50/60 cycle outlet.

The welded steel chassis frame supports the two 50 mfd condensers, an associated power pack consisting of a power transformer and rectifier tube, and a special current transformer through which the condenser bank is discharged. The current transformer secondary bars extend through the front panel and are connected to the charging bar, or special adapter, which is arranged with the magnet for optimum induction of the charging magnetic flux.

The standard flat and I-bars provided with the unit can be adapted to charge most common magnet shapes. Special adapters are available for charging complex shapes, rotor magnets, ring magnets and various assemblies. In any case where an existing adapter is not adequate, our engineering department will design a special fixture and furnish drawings at no charge, or we will make it at a firm, quoted price, whichever way you prefer. In addition to the bar method of charging on the front end assembly, a terminal strip at the rear of the unit (covered by a protective, angle plate) allows for connection to special wound charging fixtures for the few instruments and devices which do not lend themselves to bar charging.

The Model 107A weighs 75 lbs. and measures 12" x 7" x 17" over-all. It uses about 15 watts.

NOTE

All exterior surfaces, including the front end charging bar assembly, of the Model 107A may be touched during any part of the charging cycle without danger of electrical shock or discomfort.

THEORY OF OPERATION

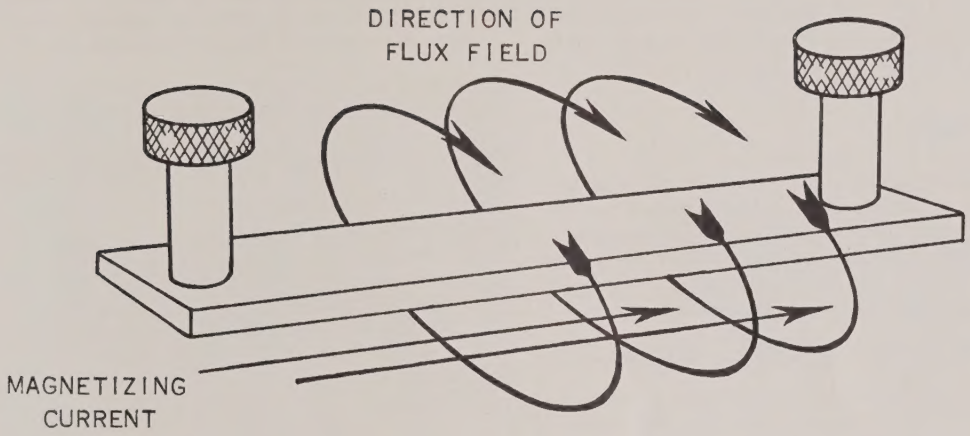

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Figure 2.

The condenser discharge is controlled by an ignitron tube operated by a push button on the front panel. The storage condenser bank has a capacity of 100 microfarads and is charged to approximately 600 volts on high range and 400 volts on low range. This charge is indicated by the voltmeter on the front panel. When the ignitron tube is triggered, the condenser discharges in about 0.002 second, producing a high current surge in the charging bar, exceeding 24,000 amperes peak value on the high range.

The circuit design and mechanical arrangement of parts result in a very low current reversal; however, for small magnets or those having low coercive force, the low range is provided to further minimize the relative effect of this reversal.

In designing adapters or analyzing the best procedure to charge an assembly, remember that the energy required to charge a magnet is proportional to the reluctance of the magnetic circuit; the air gap should be small. Where possible, a keeper (soft iron) should be used, but in any event the total air gap distance when charging should never exceed the air gap with which it is operated.

INSTALLATION AND OPERATION

Unpacking

Remove nails from bottom of both sides and ends of wood crate and lift it off exposing the wrapped unit which is bolted to a 2 x 10 wood base. Remove the four 5/16''-18 hex head bolts holding the charger to the base. Unwrap and lift unit by handle on top of case. DO NOT LIFT BY FRONT END CHARGING BARS. These are copper and will not support much weight without bending.

Preliminary Check

After unpacking, place unit on bench and plug into 115-volt, 60-cycle outlet. Check two knurled thumbscrews to make sure they're tight on flat charging bar. Snap range switch to HI and power switch to ON. Pilot light should glow, and meter pointer should rise steadily to about 600 volts in a few seconds.

REMOVE YOUR WATCH. Don't wear a watch while operating the Charger. The magnetic field around the charging bar may magnetize it.

Push discharge switch, and meter pointer should drop quickly to zero. After turning power switch OFF, push discharge button once or twice until meter rests on zero. If desired, the Charger may be left connected in the line indefinitely with the power switch ON without danger or damage.

General Charging Procedure

After placing magnet around flat bar, I-bar or in special adapter, as the case may be, securely tighten knurled thumbscrews to minimize contact resistance (note that thumbscrews have holes so that pieces of drill rod may be inserted to obtain increased leverage in tightening). The charging circuit through the secondary carries a heavy current at low voltage, and contact resistance in the joints will seriously impair charging efficiency. The front end assembly is silver-plated for maximum conduction; however, all joints should be kept clean, flat and tight. Any burned or pitted spots that develop in service should be removed with fine emery cloth. Contact resistance usually results in welding or arcing at the contact points. However, as an additional precaution occasionally operate the charging button about twenty times and test the joint for local heating with the tip of your finger. If it stays cool you can be sure that it is conducting properly.

Two ranges of charging current are available: LO position supplies about 12,000 ampere-turns and HI position 24,000 ampere-turns through the I-bar. The maximum characteristics of any permanent magnet can be achieved only by complete saturation and, once this point is reached, further or greater application of induced charging flux will serve no useful purpose. For small magnets or those having low coercive force (less than 10,000 ampere-turns) use the LO range position. The following table shows the required forces for complete saturation of typical magnetic materials:

Material	Oersteds	Ampere-turns/inch
Chromium & Tungsten Steels	300	600
Cobalt Steels	1,200	2,400
Alnico I, II, III	2,000	4,000
Alnico IV, V, VI, XII	3,000	6,000
Cunife I & Cunico	3,000	6,000
Indox I	10,000	20,000
Silmanal	20,000	40,000

These magnetizing force values are minimum to be applied to the magnet; they must be increased in practice to overcome losses in the joints of the charging bar, steel yoke or keeper, and whatever air gap exists in the magnetic circuit. These losses can be kept to a minimum by proper adapter design and clean electrical joints.

Although in most cases one charging impulse appears to saturate the magnet, a minimum of three impulses is recommended. Often the first impulse serves to burn out some small amount of contact resistance in the charging bar circuit, and the second impulse is considerably stronger. Also repeated impulses often improve the inherent stability, minimizing the amount of treatment necessary for proper stabilization. For large magnets requiring forces approaching the Model 107A's maximum output, repeated impulses (up to 20 or 30) will often "pump" the magnet to saturation.

When charging instrument assemblies or magnets having a charging bar clearance which is appreciably larger than the width of the bar, the magnet should be held so that the bar is approximately in the center of the magnetic field. Otherwise, the magnet may saturate only in the region closest to the bar, because of poor distribution of the charging flux.

When a keeper is used do not remove it - for even an instant - until the moving coil has been replaced, or the magnet is installed in its regular assembly or circuit.

Using the I-Bar

The I-Bar is shipped attached to the bottom of one of the thumbscrews beneath the flat charging bar. For use it is threaded through the magnet assembly and attached to the secondary bars by the two thumbscrews as shown in figure 3. Charging current travels up the I-bar, inducing lines of magnetic force in a counter-clockwise direction.→

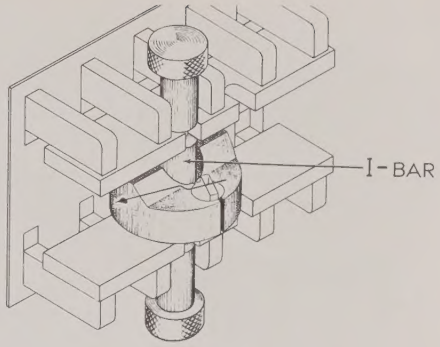

Figure 3.

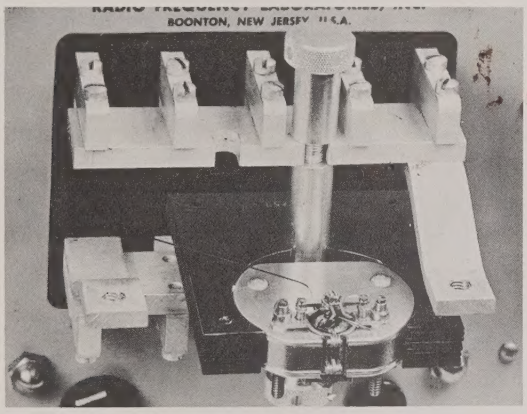

Figure 4.

←The I-bar makes maximum use of the charging current and presents least inductance of any type of charging bar or adapter. It should be used where maximum induced flux is required.

Using the laminated fixture (Yoke S-1) shown, a Simpson Model 260 meter can be charged without removing its coil and pointer assembly.

Using the Flat Bar

The flat bar is used for most panel type instrument assemblies, horseshoe and toroid types, and is the foundation of many special adapters for rotor magnets and various complex shapes. Figure 5 shows a typical panel instrument in charging position. Before tightening thumbscrews on bar, make sure instrument is facing proper direction for correct polarity, as indicated by figure 2.→

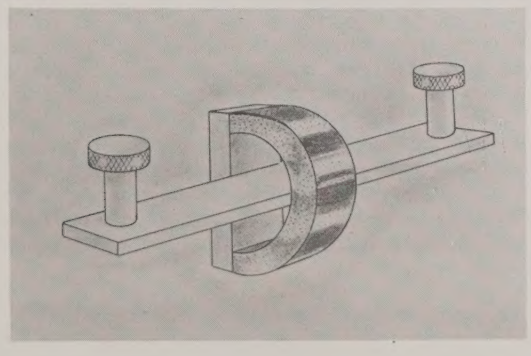

Figure 6.

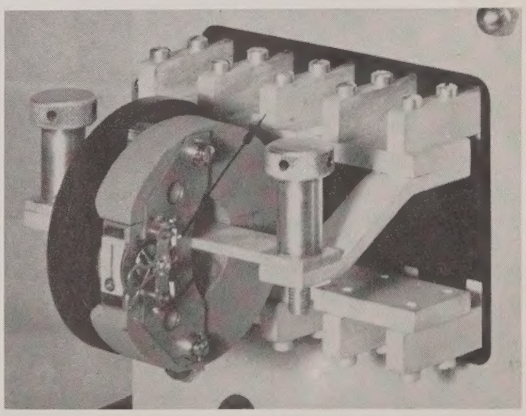

Figure 5.

←Figure 6 illustrates the use of an iron keeper in charging a typical horseshoe shaped magnet. Various forms of keepers or yokes can easily be made from scraps of iron or steel to fit different magnet shapes - their need and use are identical in every respect; they close the air gap, so that after saturation the highest residual magnetism is retained. They should be left on the magnet until it is assembled into its final circuit.

Special Adapters

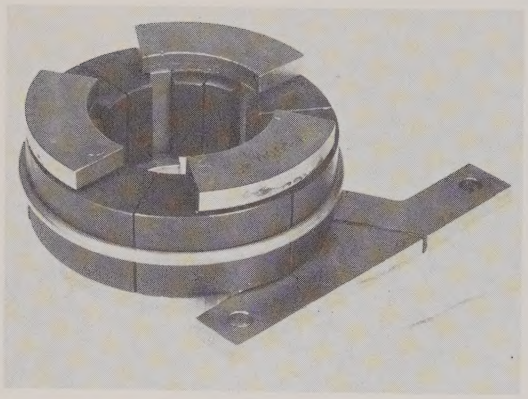

Figure 7.

←There are some magnets that cannot be threaded over the I-bar or flat bar, nor will a simple yoke or keeper suffice. Typical of this class are the multiple pole, cylindrical rotor magnets, whose poles may be parallel to the axis of rotation or lie on a helix. A typical adapter for a 6-pole rotor magnet is illustrated in figure 7. It fastens on the front end assembly in the same position as the flat bar, using the two knurled thumbscrews. The magnet is inserted into the center opening with the desired pole positions opposite the iron pole pieces. After charging, it should be slid up into a keeper held down against the adapter or into its field assembly. During transfer it should not be exposed to an air gap greater than exists in its final circuit after assembly.

Special adapters for most of the aircraft indicating instruments manufactured by Bendix (Eclipse-Pioneer Division), Curtiss-Wright, General Electric, Hamilton Standard, Jack & Heintz, Kollsman and Weston are available and are listed in a separate folder. The adapter shown in figure 8 charges the Weston Model 882 Position Indicator. The magnet with pointer mounted should be placed in the fixture with the pointer tip pointing to its proper marking on the engraved ring. Adapters similar in design can be used for unit or group charging of compass needles and rod or bar magnets of various lengths. Keepers are not usually required for this type, since most of them operate in a completely open circuit with infinite gap.→

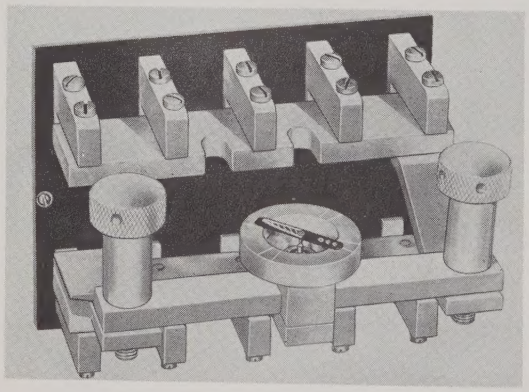

Figure 8.

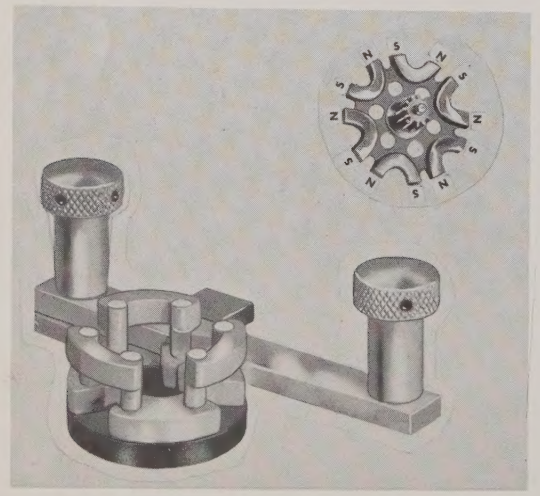

Figure 9.

←The adapter in figure 9 shows how a fairly complex 12-pole, disc shaped rotor magnet assembly can be charged. An adapter of this type is an individual design and fabrication problem, since it will be used for one user's magnets only and cannot be modified for a general type of magnet, such as loudspeaker magnet assemblies which can be charged with Adapter XA-4339.

For any new shape of magnet or assembly where existing adapters are not suitable, we'll be glad to design whatever fixture is required, as a free service to owners of the Model 107A. Send a dimensional sketch of the proposed magnet or, where possible, an actual sample.

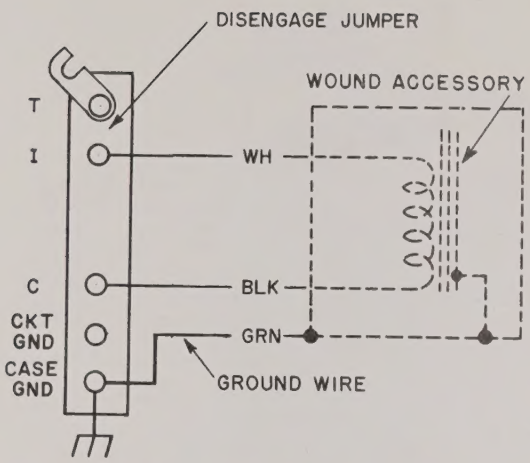

Figure 10.

In a few cases, as in ring magnets, it is desirable to use a special wire wound fixture through which the condenser bank can be directly discharged to produce the charging flux. For this purpose a rear terminal strip is provided, and the fixture should be connected as shown in figure 10. The ground wire normally carries no current but is recommended as a safety precaution in the event an internal ground develops in the fixture. The jumper bar should be disengaged when connecting to an external fixture, so as to disconnect the built-in current transformer. The charging current discharge button on the front panel functions in the same manner as for front end operation.

WARNING

BEFORE REMOVING REAR ANGLE COVER PLATE, PULL POWER PLUG AND PUSH DISCHARGE SWITCH BUTTON UNTIL METER READS ZERO. THE 600-VOLT INTERNAL CIRCUITS ARE DANGEROUS.

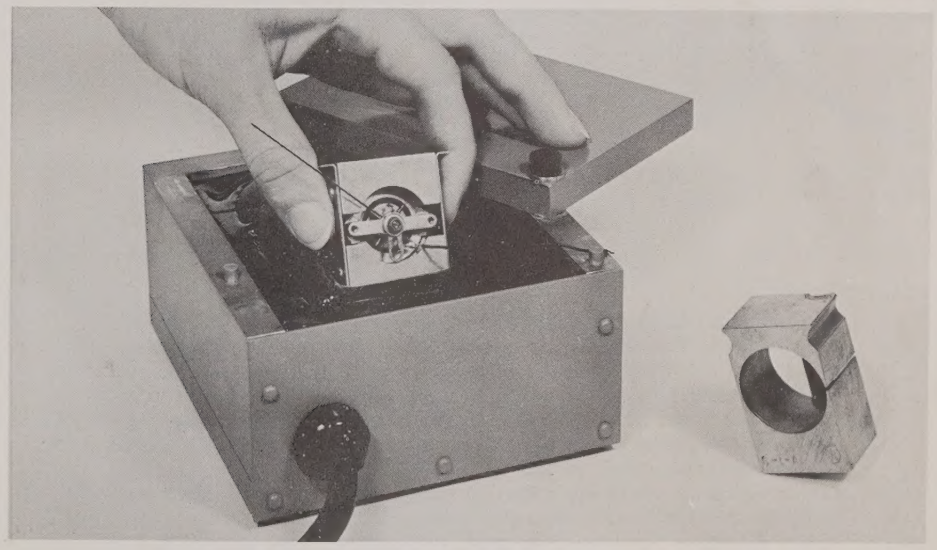

Figure 11.

As an additional precaution, the high capacity condenser bank can be discharged by placing an insulated discharger bar across the lugs of the condenser before any checks are made on the internal parts. When using wound fixtures be sure the lead wires are adequately insulated for 600 volts.

If you plan to construct a wound fixture, it's recommended that the winding have a designed resistance from 10 ohms for one square inch of iron section to 40 ohms for one-quarter square inch of iron section. The design should also provide the shortest feasible length of iron as the first consideration and, secondarily, the greatest weight of copper winding.

Figure 11 illustrates use of Basic Fixture XD-4128 for core type instrument mechanisms. This fixture accommodates various inserts for different magnet diameters. After the mechanism has been placed in center of coil, the iron cover plate is swung closed before the charging button is pushed. Two or three pulses are sufficient. When charging the large 1" diameter core magnets, the Model 206 Booster Unit should be used to insure saturation.

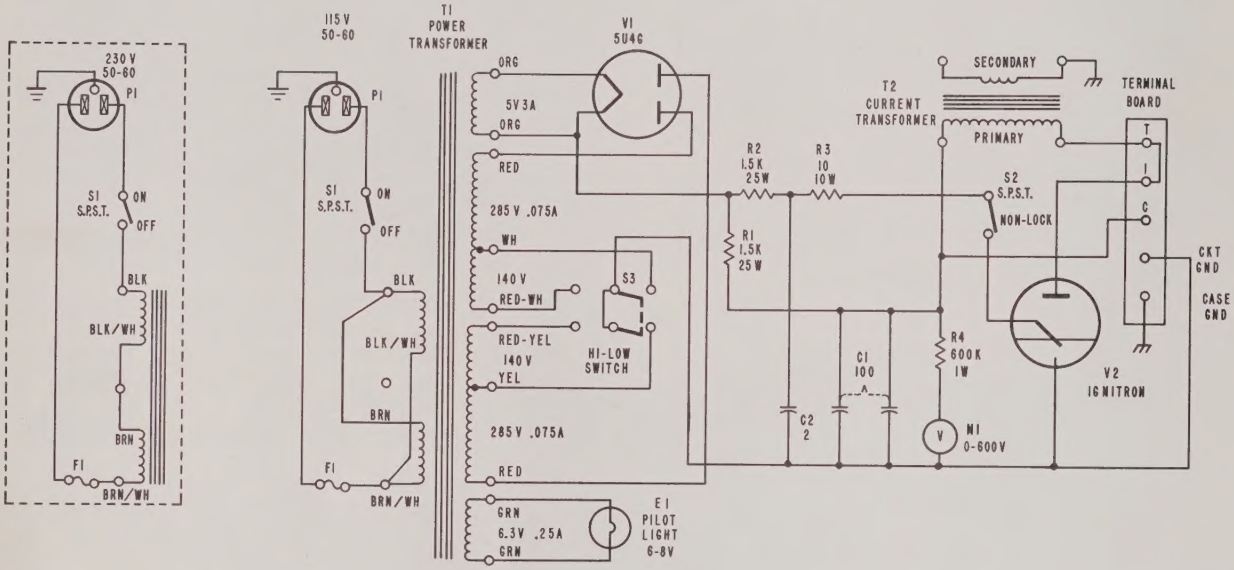

Figure 12.

No special tools are required for servicing the Model 107A Magnet Charger. The circuit can be checked for continuity with an ohmmeter, but most likely cause of trouble will lie in pitted or burned spots in charging bar joints. Occasionally the rectifier tube will go, in which case the meter on the front panel will not indicate any voltage when the power switch is ON. A faulty ignitron can be suspected if the meter pointer does not drop quickly to zero on pushing the charging button (make sure the charging bar is tightly in place completing a circuit for the charging current transformer secondary). If the charging bar circuit is open, an audible thump will be heard if the discharge button is pushed - not a recommended practice.

Before removing the case, pull the power cord and DISCHARGE CONDENSERS UNTIL VOLTMETER READS ZERO. With Phillips screwdriver remove the eight truss head machine screws at bottom of both sides and the eleven sheet metal screws around the edges of the front panel. Work case off lifting upward.

If unit does not function properly and all electrical components seem to be working, write or telephone (DEerfield 4-3100) giving a brief list of symptoms. We can then suggest a remedy or send a replacement Charger which you can use until yours has been returned and repaired.

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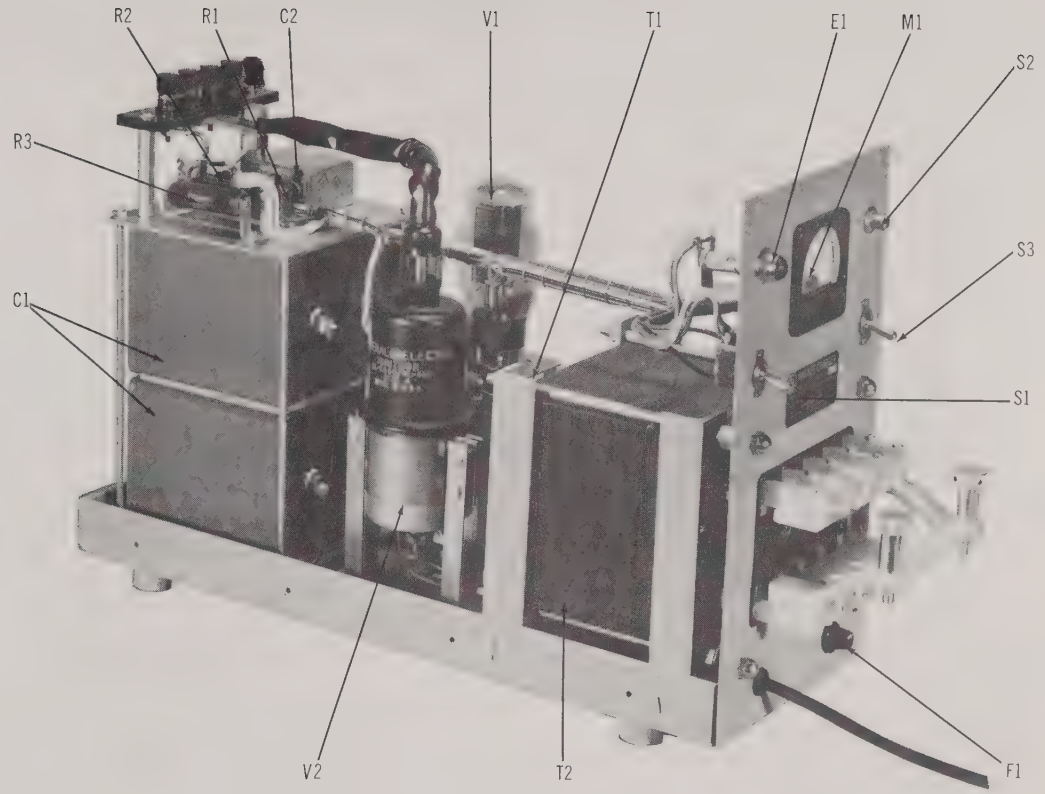

Figure 13.

SYMBOL	DESCRIPTION	NO. REQ.	RFL PART NO.
E1	BULB: 6-8 volt, T 3-1/4.	1	HA-1045
	CABLE: 3 cond. #16, .360 dia.	7'	HA-7750
	CABLE: power.	1	HA-8875
C1	CAPACITOR: 50 mf, 600 v DC w.	2	HA-1609
C2	CAPACITOR: 2 mfd, 600 v DC, paper.	1	HA-1259
F1	FUSE: 2 amp, 3 AG.	1	HA-1289
	FUSEHOLDER	1	HA-1816
M1	METER: 0-600 volts, sensitivity 0-1 ma.	1	HB-6303
R1	RESISTOR, WW: 1.5K, ±10%, 25 w.	2	H-1100-8
R2	RESISTOR, WW: Same as R1.		
R3	RESISTOR, WW: 10 ohm, ±10%, 10 w.	1	H-1100-38
R4	RESISTOR: 600K, ±1%, 1 w.	1	H-1510-2
	SOCKET, tube.	1	HA-4787
S1	SWITCH, toggle: SPST.	1	HA-1574
S2	SWITCH, sensitive: plunger.	1	HA-6144
S3	SWITCH, toggle: DPDT.	1	HA-7036
	TERMINAL BLOCK: 4 terminal.	1	HA-10264
T1	TRANSFORMER, power.	1	HA-21020
T2	TRANSFORMER, current.	1	HC-1577
V1	TUBE, electron: rectifier; 5U4G.	1	HA-1278
V2	TUBE: ignitron. *	1	HA-1595

* Do not replace from open stock; this tube must pass low voltage test - should be purchased from RFL.

Model 206A Booster Unit

Figure 14.

DESCRIPTION. The Model 206A Booster Unit consists of a 100 mfd condenser bank which, when used with the Magnet Charger, increases the latter's peak current output in excess of 28,000 amperes. With the Model 107A its primary use is in charging large Alnico magnets with wire wound fixtures; it is seldom required for front end charging. The Booster Unit can also be used with the Magnetreater to furnish the necessary 100 mfd capacitance, where the Magnet Charger is not available.

It is designed for repeated surge discharge under conditions of continuous production operation. Overall size is 10'' x 8'' x 7''; weight is 15 lbs.

ATTACHING TO CHARGER. Unscrew the four sheet metal screws from the rear angle plate on the Charger and remove plate. Plug Twist-lock connector on standard cable HA-7229 into receptacle in Booster and connect lug marked GND on cable to CKT GND on post Charger terminal strip and connect other lug to adjacent lug C. After cable is connected the charging procedure follows normal sequence.

WARNING

Before connecting or disconnecting Booster Unit, remove Model 107A's power plug from line and push discharge button until voltmeter reads zero. Accidental contact with capacitor terminals of either unit, when charged, can result in serious injury or death.

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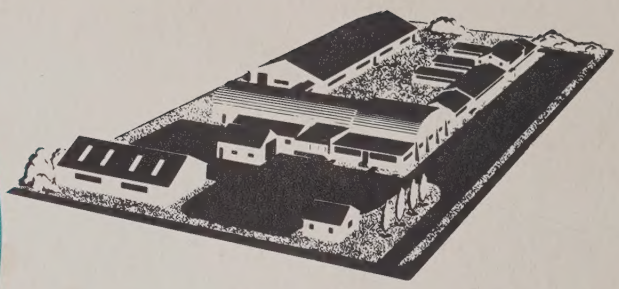

Warranty

The Model 107A Magnet Charger carries a warranty of 12 months from date of delivery for replacement of any part, except tubes, which fails during normal operation or service. A deficient part should be returned to the factory, shipping charges prepaid, for replacement f. o. b. Boonton, N. J.

Radio Frequency Laboratories, Inc.
BOONTON, NEW JERSEY, U.S.A.

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Manufacturers of

MAGNETICS EQUIPMENT

POWER SUPPLIES

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CRYSTAL IMPEDANCE METERS

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DESIGNERS AND MANUFACTURERS SINCE 1922